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Page 2 de l'attestation

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Picture display device with reduced deflection power

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Picture display device with reduced deflection power

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BACKGROUND OF THE INVENTION

The invention relates to a picture display device comprising :

– a cathode ray tube comprising an elongated display screen with a long axis and a short axis, a cone portion whose cross section has an elongated shape with a long axis and a

5   short axis, a neck comprising means for generating at least one electron beam, and

– a deflection system mounted on said cone portion for generating electromagnetic fields for deflecting said electron beam(s).

A picture display device as described above is known from US patent nr.

10   5,962,964. The CRT of said known display device comprises a cone portion whose cross section varies gradually from a circular shape at the neck end of the cone portion to a rectangular shape at the display screen end of the cone portion.

At the reference deflection plane – which is the plane perpendicular to the cathode ray tube axis and going through the point of intersection between the cathode ray

15   tube axis and the asymptote to the trajectory of the electron beam when deflected to a corner of the display screen - the cone portion of said known display device has a cross section which has a substantially rectangular shape. The deflection system can therefore be positioned closer to the envelope of the electron beam(s) than within CRTs whose cone have circular cross sections. Magnetic losses are thereby reduced and as a result less deflection

20   power is needed.

According to US patent nr. 5,962,964, deflection power consumption reductions between 17% and 25% can be achieved.

There is nevertheless a wish to further reduce the power consumption of the deflection system.

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SUMMARY OF THE INVENTION

It is an object of the invention to provide a picture display device with further reduction of the deflection power.

To this end, in accordance with an aspect of the invention, the picture display device is characterised in that the deflection system is arranged to scan the electron beam(s) along lines substantially parallel to the short axis of the display screen and in that the part of the cone portion which is under the deflection system has at least one cross section whose

5 internal outline has a long axis/short axis ratio (A_c) larger than or equal to the long axis/short axis ratio (A_{scr}) of the display screen.

The present invention enables a further reduction of deflection power of around 30% compared to the cited prior art. This reduction is essentially achieved by

10 reducing the line deflection power, which is the major consumer in the deflection system.

The line deflection power is reduced by reducing the sweep amplitude, which is being achieved by scanning the lines substantially parallel to the short axis of the display screen (called transposed scan)instead of parallel to the long axis of the display screen (called normal scan) and the line deflection power is further reduced by reducing magnetic losses

15 which is being achieved by bringing the line deflection system closer to the electron beam envelope, being particularly attentive to the aspect ratio of the latter.

The inventors have realised that with transposed scanning the aspect ratio of the cross section of the electron beam envelope (A_{el}) in parts of the region under the deflection system is larger than or equal to A_{scr}, in contrast to normal scanning.

20 Based on this insight, the picture display device in accordance with the invention comprises a cone portion whose cross-section in parts of the region under the deflection system has an aspect ratio (A_c) which is also larger than or equal to A_{scr}.

In preferred embodiments, A_{el} exceeds A_{scr} in parts of the region under the deflection system to the extent that $(A_{el}-1)/(A_{scr}-1) \geq 1.1$, and therefore it is advantageous

25 that A_c also exceeds A_{scr} to the extent that $(A_c-1)/(A_{scr}-1) \geq 1.1$ in parts of that region.

In the region between the reference deflection plane and that end of the deflection system nearest to the display screen – which is the region where most of the magnetic field is concentrated – it is also advantageous that the cross section of the cone has a shape which follows as closely as possible the shape of the electron beam envelope.

30 Therefore, it is advantageous that in this region A_c first increases, goes through a maximum and then decreases.

Furthermore, the reduction of deflection power grows with growing screen aspect ratios. The invention is thus particularly effective for picture display devices with

large screen aspect ratios. In particular, the invention is advantageous for picture display devices with $A_{scr}>4/3$, and a fortiori for picture display devices with $A_{scr}\geq16/9$.

5   The economy of deflection power may be used advantageously to increase the maximum deflection angle of the electron beam(s). In preferred embodiments, maximum deflection angles larger than or equal to 120° are being realised. This is useful to build more slim CRTs.

BRIEF DESCRIPTION OF THE DRAWINGS

10   These and further aspects of the invention will be explained in greater detail by way of example and with reference to the accompanying drawings, in which:

FIG.1 is a sectional view of a picture display device according to an embodiment of the invention;

15   FIG.2 is a sectional view of the display window;

FIG.3a and 3b are schematic representations of a cross section of a picture display device under the deflection system, respectively according to prior art and according to an embodiment of present invention, showing the principle of normal scanning versus transposed scanning;

20   FIG.4a is a cross section of the electron beam envelope in the region under the deflection system;

FIG.4b is a graph showing the values of the aspect ratio of the electron beam envelope along the z-axis for a CRT with normal scanning and with transposed scanning;

FIG.5a and 5b are schematic representations of a cross section of a picture

25   display device under the deflection system, showing the difference in cone aspect ratios; and

FIG.6 is a graph showing the values of the aspect ratio of the electron beam envelope along the z-axis for a CRT with transposed scanning for various screen aspect ratios and for various maximum deflection angles.

30   The Figures are not drawn to scale. In general, like reference numerals refer to like parts.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A picture display device according to a preferred embodiment of the invention is shown on FIG.1.

It comprises a cathode ray tube (1), which includes a display window (2), a
5   cone portion (3), and a neck (4). In the neck (4), there is a means (5) for generating at least one electron beam (6). In this exemplary embodiment, three electron beams are generated in one plane (the in-line plane). The inner surface of the display window (2) comprises a large number of phosphor elements which form a display screen (8). When the electron beam (6) hits a phosphor element, the latter becomes phosphorescent, thereby creating a visible spot on
10   the display screen (8). In the undeflected state, the electron beam (6) substantially coincides with the tube axis (7). On its way to the display screen (8), the electron beam (6) is deflected by means of a deflection system (9) covering a part (3a) of the cone portion (3). Said deflection system (9) comprises a line deflection subsystem (12) and a frame deflection subsystem (13), in order to create a two-dimensional picture on the display screen (8). In this
15   exemplary embodiment, the deflection system (9) is made up of sets of coils, one set for the line deflection subsystem (12) and another set for the frame deflection subsystem (13).

FIG.1 also shows the reference deflection plane (11) which is a plane perpendicular to the tube axis (7) and going through the point of intersection between the tube axis (7) and the asymptote to the trajectory (10) of the electron beam when deflected to a
20   corner of the display screen (8).

As can be seen from FIG. 2, the display screen (8) has an elongated shape with two perpendicular axes of symmetry : a long axis (21) whose length is L_{scr} and a short axis (22) whose length is S_{scr}. In order to quantify the amount of elongation of the display screen (8), the aspect ratio of the display screen (8) is defined as $A_{scr} = L_{scr}/S_{scr}$.

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We also define the maximum deflection angle as being the angle θ between the tube axis (7) and the deflected electron beam (10) when the electron beam is deflected so as to hit a point on the display screen (8) which is the furthest away from the intersection between the tube axis (7) and the display screen (8).

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FIG. 3a and 3b schematically show a cross section of a picture display device in a region (3a) where the cone portion (3) is under the deflection system (9), respectively according to prior art (FIG.3a) and according to an embodiment of present invention (FIG.3b). As can be seen on those figures, a cross section (32a,b) of the cone portion under

the deflection system (9) has an elongated shape with two perpendicular axes of symmetry : a long axis (21a,b) whose length is L_c and a short axis (22a,b) whose length is S_c. In order to quantify the amount of elongation of the cross section of a cone portion , the aspect ratio of the cross section of a cone portion is defined as

5      $A_c = L_c/S_c$.

With prior art (Fig.3a), the line deflection subsystem (12a) deflects the electron beam (6) so as to scan the display screen (8) along lines substantially parallel to the long axis (21a) of the display screen (called normal scan).

According to the invention (FIG.3b), the line deflection subsystem (12b)

10   deflects the electron beam so as to scan the display screen (8) along lines substantially parallel to the short axis (22b) of the display screen (called transposed scan), and a cross section (32b) of the cone portion under the deflection system (9) has an aspect ratio A_c which is larger than the aspect ratio of the display screen (A_{scr}).

15   With transposed scan, the line deflection power can be reduced thanks to the reduced sweep amplitude.

The inventors have also realised that with transposed scan, the electron beam envelope in part of the region under the deflection system (9) has a particular shape. As can be seen on FIG.4a, a cross section (40) of the electron beam envelope in said region has an

20   elongated shape with a long axis (41) whose length is L_{el} and a short axis (42) whose length is S_{el}. In order to quantify the amount of elongation, we define the aspect ratio of a cross section of the electron beam envelope as being $A_{el} = L_{el}/S_{el}$.

FIG.4b is a graph showing a curve with values of A_{el} along the tube axis Z(7)

25   for a display screen (8) with an aspect ratio $A_{scr}=16/9$, both for normal scan (curve 43) and for transposed scan (curve 44).

In the region under the deflection system (z=-0.03 to z=+0.04), the value of A_{el} for transposed scan grows quickly towards the value of A_{scr}, and even exceeds it, in contrary to normal scan. This characteristic holds for various screen aspect ratios (ex. 4/3 and

30   16/9) and for various maximum deflection angles (ex. 105°, 110° and 120°), as can be seen from FIG.6.

Based on this insight, a picture display device according to present invention comprises a cone portion in part of the region under the deflection system (9) whose cross-section has an aspect ratio (A_c) which is also larger than or equal to A_{scr}.

This allows to bring the deflection system (9), and in particular the line deflection subsystem (12), much closer to the electron beam envelope, thereby reducing magnetic losses and as a result reducing the deflection power.

Such effect is illustrated on FIG.5a and FIG.5b. Both schematically show a cross section of a picture display device in part of the region (3a) under the deflection system (9). FIG.5a shows a cone cross section (53) with an aspect ratio A_c which is smaller than the aspect ratio A_{scr} of the display screen (8), whereas FIG.5b shows a cone cross section (54) with an aspect ratio A_c which is larger than the aspect ratio A_{scr} of the display screen (8), thereby enabling to position the line deflection subsystem (12) closer to the electron beam envelope (51).

The aspect ratio A_c of known picture display devices varies gradually from 1 to A_{scr}, without ever getting equal to, neither exceeding A_{scr}. Typical examples are given in US patent nr. 5,962,964 for a 4:3 screen ($A_{scr} = 1.333$), wherein $A_c = 1.2$ at the reference deflection plane (11).

In preferred embodiments according to present invention, A_{el} exceed A_{scr} to the extent that

$(A_{el}-1)/(A_{scr}-1) \geq 1.1$ in part of the region under the deflection system (9), and therefore it is advantageous that A_c also exceeds A_{scr} to the extent that

$(A_c-1)/(A_{scr}-1) \geq 1.1$ in that region.

It is also advantageous that, in the region between the reference deflection plane (11) and that end of the deflection system (9) nearest to the display screen (8) – which is the region where most of the magnetic field is concentrated – the cross section of the cone has a shape which follows as closely as possible the shape of the electron beam envelope. Therefore, it is advantageous that in this region A_c first increases, goes through a maximum and then decreases.

Moreover, the power reduction effect increases with growing screen aspect ratios, so that present invention is particularly attractive for new type picture display devices with large screen aspect ratios such as $A_{scr} > 4/3$, and a fortiori for $A_{scr} \geq 16/9$.

Overall, a picture display device according to present invention can reduce the deflection power by around 30% compared to prior art.

5   A further merit of the invention is that the reduction in deflection power can be used advantageously to increase the maximum deflection angle. The depth of the CRT can be reduced in this way, leading to more slim picture display devices.

It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative
10   embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. The word "comprising" does not exclude the presence of other elements or steps than those listed in a claim. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

CLAIMS:

1.   A picture display device comprising

–   a cathode ray tube (1) comprising an elongated display screen (8) with a long axis (21)
    and a short axis (22), a cone portion (3) whose cross section has an elongated shape with
    a long axis and a short axis, a neck (4) comprising means (5) for generating at least one
5   electron beam (6), and

–   a deflection system (9) mounted on said cone portion (3) for generating electromagnetic
    fields for deflecting said electron beam(s) (6),

characterised in that the deflection system (9) is arranged to scan the electron beam(s) (6)
along lines substantially parallel to the short axis (22) of the display screen (8) and in that the

10 part of the cone portion (3a) which is under the deflection system (9) has at least one cross
section whose internal outline has a long axis/short axis ratio (A_c) larger than or equal to the
long axis/short axis ratio(A_{scr}) of the display screen (8).

2.   Picture display device according to claim 1, characterised in that the part of

15 the cone portion (3a) which is under the deflection system (9) has at least one cross section
whose internal outline has a long axis/short axis ratio(A_c) larger than the long axis/short axis
ratio(A_{scr}) of the display screen (8).

3.   Picture display device according to claim 2, characterised in that

20              $(A_c - 1)/(A_{scr} - 1) \geq 1.1$.

4.   Picture display device according to claim 2 or 3, characterised in that the part
of the cone portion (3) between the reference deflection plane (11) and that end of the
deflection system (9) nearest to the display screen (8) has a cross section whose internal

25 outline has a long axis/short axis ratio (A_c) which first increases, goes through a maximum
and then decreases.

5.   Picture display device according to anyone of claims 1 to 4, characterised in
that $A_{scr} > 4/3$.

6.   Picture display device according to claim 5, characterised in that $A_{scr} \geq 16/9$

7.   Picture display device according to any one of claims 1 to 6, characterised in

5   that the maximum deflection angle of the electron beam(s) (6) is larger than or equal to 120°.

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ABSTRACT:

A picture display device comprising a cathode ray tube (1) with an elongated display screen (8) and a deflection system (9). Deflection power is reduced by two means. The deflection system (9) is arranged to scan the lines in the direction of the short axis (22) of the display screen (8), and the cone portion (3) of the cathode ray tube (1) has an elongated

5   cross section (54) whose aspect ratio is larger than or equal to the aspect ratio of the display screen (8), thereby enabling the deflection system (9) and in particular the line deflection subsystem (12) to be positioned closer to the electron beam envelope (51), which reduces the magnetic losses.
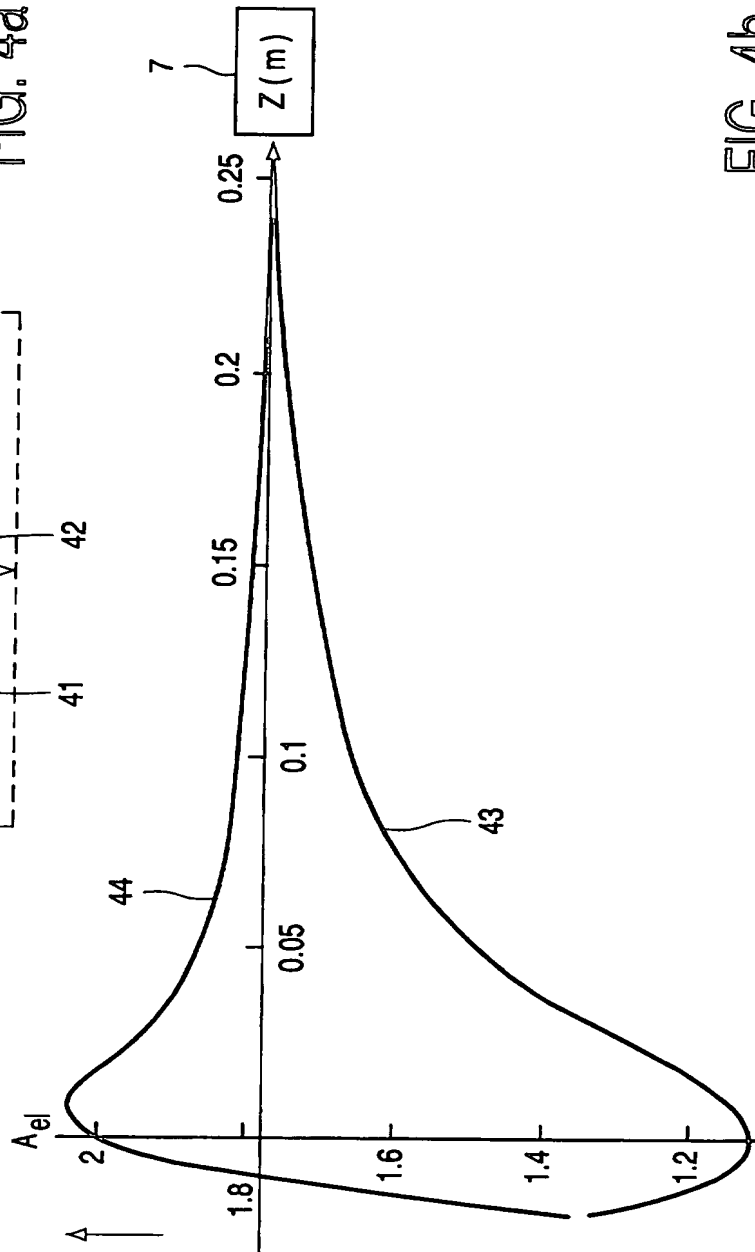

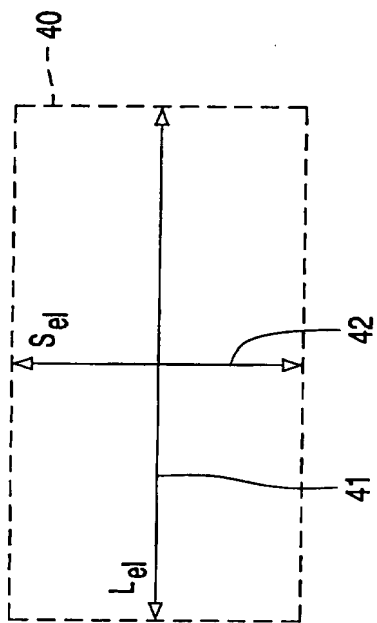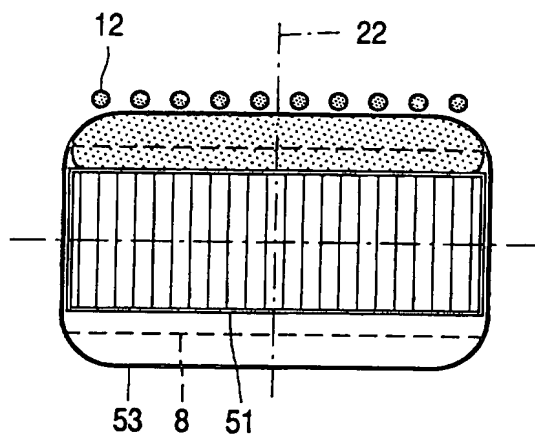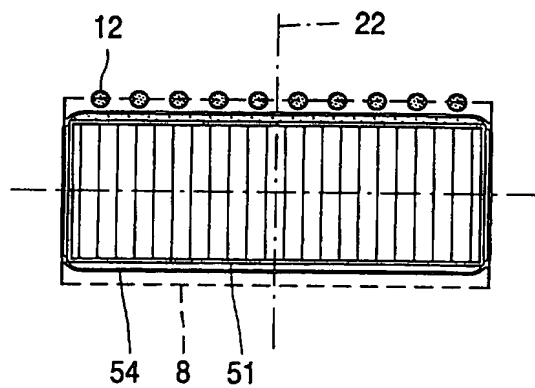10   Fig 1 and Fig 5b

FIG. 1
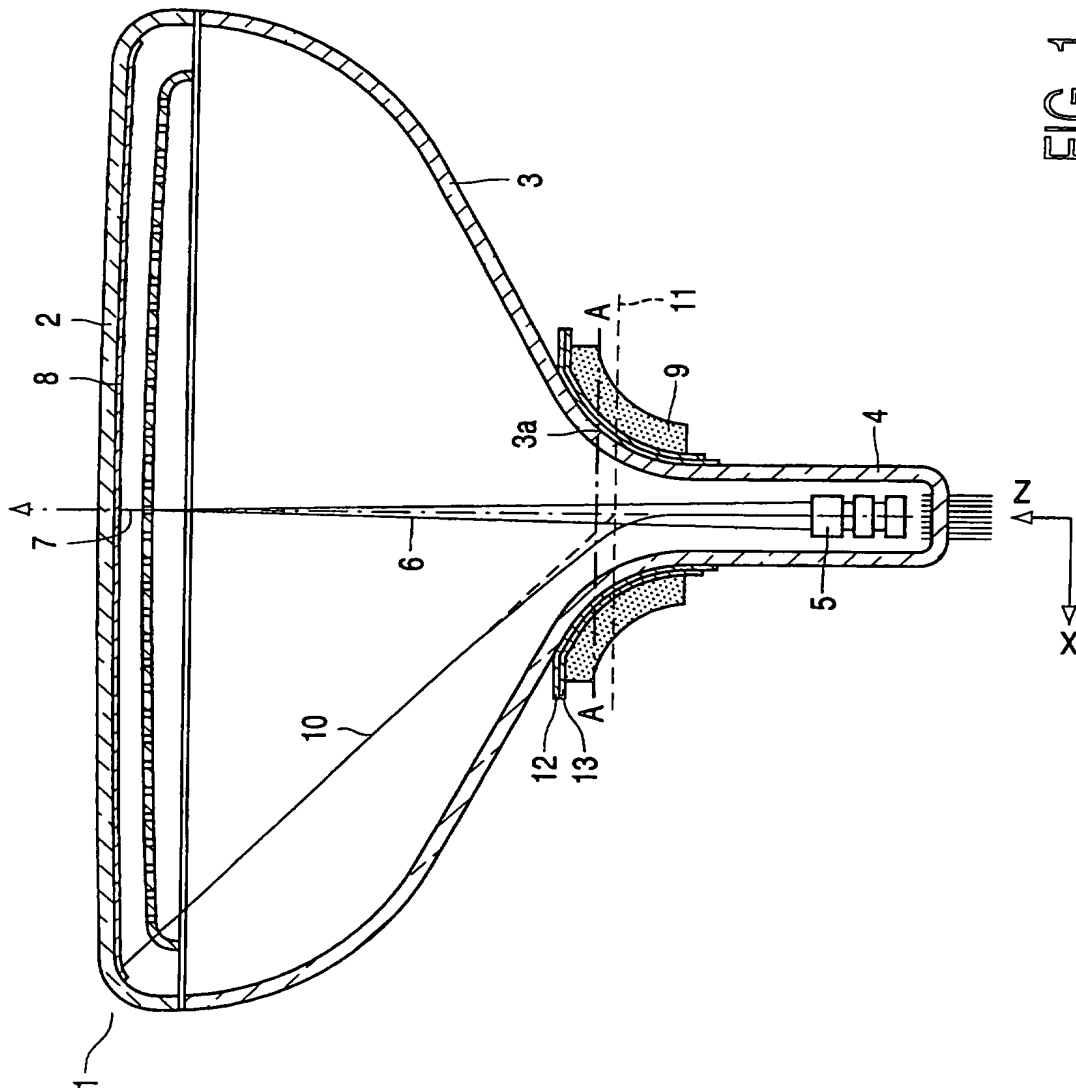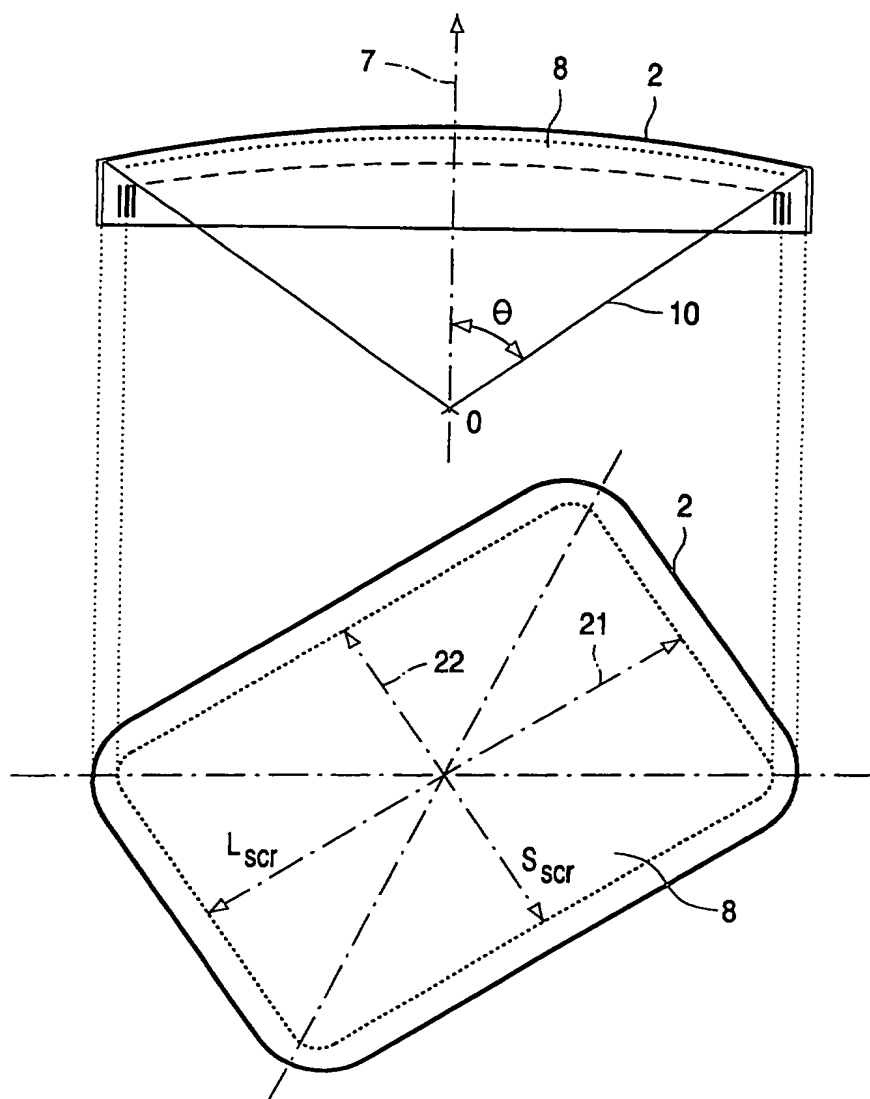
FIG. 2
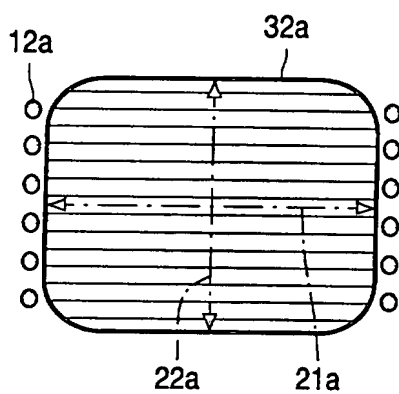
FIG. 3a
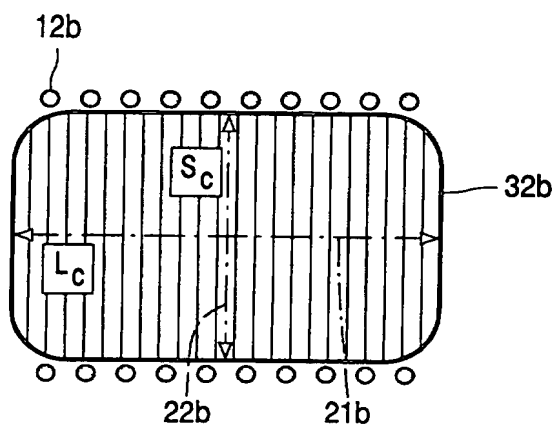
FIG. 3b

4/6

FIG. 4a

FIG. 4b

5/6

FIG. 5a

AA section

FIG. 5b

AA section

FIG. 6